

Copy No. 13

Contribution of the Geographic Research Area, ORR, to
HIE 11-6-59

Soviet Science and Technology

OLA/RR G/11 59-23a

(ORR Project 60.1761)

13 March 1959

WARNING

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE
NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE
MEANING OF THE ESPIONAGE LAW, TITLE 18, USC,
SECS. 793 and 794, THE TRANSMISSION OR REVELATION
OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON
IS PROHIBITED BY LAW.

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

Contribution to NIE 11-6-59

Physical Sciences

SUMMARY

Soviet policy has always recognized that a strong national geodetic and cartographic system is essential for planning the growth of the nation. Large-scale mapping of the USSR and European Satellite areas has already progressed to a point where it is adequate for military requirements. Soviet geodetic interest now is directed toward "whole earth" studies of the crust and figure of the earth which will determine relationships between the actual land surface, the geoid, and the ellipsoid of reference. Military positioning requirements for ICBM warfare probably provide the strongest motive for intense Soviet interest in earth science today. Nevertheless, in the conquest of science as a pathway toward world supremacy the Soviets are keenly aware that geodesy holds forth the promise of scientific distinction to that nation which can first establish a world geodetic datum.

The Soviet Union has secured gravity data from other nations, and is making gravity observations in Antarctica wherever Soviet ships undertake oceanographic research. Soviet concern over the design and construction of new gravimeters with which to make gravity observations on moving surface vessels and airplanes is much in evidence. Technological success in building such gravimeters will result in greatly augmented programs of oceanic gravity measurement and eventually in a more precise figure of the earth. The Soviet Union, like the US, anticipates geodetic gain from observations made possible by artificial earth satellites. The more extended orbits desirable for geodetic purposes

will be attained within the next few years. The Soviets are fully cognizant of the reconnaissance possibilities provided by satellites and will exploit these possibilities fully for whatever advantage they may provide in intercontinental positioning. The policy of withholding maps of the USSR and of not exchanging geodetic and gravity data freely with other nations has given the Soviets a positioning advantage over the West in ICBM-type warfare.

D/GG Contribution to NIE 11-6-59

Soviet policy has always recognized that a strong national geodetic and cartographic system is essential for planning the agricultural and industrial development of the nation. The production of maps of the USSR, consequently, was greatly expanded after the readjustment of horizontal control in 1942-46. The topographic series at 1:100,000 containing approximately 20,000 sheets, received the most concentrated effort and is now completed for the entire country. Geodesy, however, goes beyond merely serving as a basis for mapping control. The development of long-range weapon systems and artificial earth satellites has extended the area of practical geodetic interest to include the surface of the whole earth. Soviet theoretical geodesy reveals a keen awareness of this "whole earth" concept of modern geodesy. For very practical reasons of military urgency the geodesist today, more than ever, seeks a better determination of the figure of the earth. Ultimately, after intercontinental ties are made across the oceans, a single world geodetic datum will be a possibility. By continuing the present policy of collecting worldwide data and withholding its own geodetic data

from other nations, the Soviet Union hopes eventually to win scientific recognition as the first nation to establish a world geodetic datum.

Significant Soviet accomplishments, trends and objectives in geodesy, gravimetry, and mapping are indicated in the following categories of interest:

(1) First-order horizontal control: Soviet geodetic control has had the great advantage of a recent readjustment (1942-46), which unified into a single system all earlier first-order triangulations within the country. The new Krasovskiy ellipsoid was adopted in 1946, and new geodetic coordinates were assigned to the initial point at Pulkovo Observatory. From analysis of gravity observations over the entire area of the USSR, the Soviets uniquely were able to construct geoidal profiles along arcs of triangulation, making possible the reduction of angle and distance measurements from the earth's surface directly to the ellipsoid. The Soviet claim that this projection method is superior to other reduction methods used elsewhere in the world is probably correct. However, the relative strengths of different datums and continental nets, or the fitness of any one to serve as a world datum, cannot really be determined before methods become available for bridging the oceans geodetically.

At least two-thirds the area of the USSR is now covered by first-order horizontal control. A new field survey along the principal rivers flowing northward into the Arctic Ocean is operating continuously. Despite Soviet reluctance to reveal first-order work east of Magadan, there is reason to believe that Soviet control now extends to the Bering Strait. Estimates given privately in conversation between US and Soviet

geodesists indicate that the USSR will be completely covered by first-order horizontal control within less than 10 years.

The integration of the geodetic systems of the European Sovbloc nations with that of the USSR has been in progress since 1952. The separate national geodetic datums have been abandoned in favor of the Pulkovo 1942 Datum of the USSR, and all the necessary additional field work and the readjustment of control to the Soviet system have been completed. Mapping based on the new control is well under way in all the Satellite countries. The topographic series for East Germany at 1:25,000 is already completed (1,536 sheets). It now seems likely that the mapping program initially set up at Sofia in 1952 will be essentially completed within the next few years.

Geodetic information regarding Communist China is scant. China has purchased geodetic equipment from the West and from East Germany, and undoubtedly also from the USSR. The Soviets have sent specialists to China to formulate geodetic programs and to direct some of the field work. Thus far, no information is available regarding the progress of field work by the Chinese. Ties across the border to the Soviet net have probably been made, although there is no indication that the Soviet datum has been adopted by China. How well the Chinese data fit the Soviet datum will be a matter of great interest in the years ahead.

(2) Possible Bering Strait connection: Soviet and US control points are closest to each other at the Bering Strait. Since Alaskan geodetic data have been available to the Soviets in the past and since an accurate connection across the Strait would clearly be advantageous to them, they have probably already made a preliminary connection by

covert means or by aerial photography. Since only very poor maps of the Chukotsk area are available in the US and since the Soviets withhold information on a possible connection from the Strait to the main net in the USSR, the US would have little to gain by simply making the connection across the Strait. The Soviets have already dropped hints that, at the forthcoming Helsinki IUGG meeting in 1960, they will propose a joint operation with the US to make the tie across Bering Strait. Preparation to meet this challenge should not be neglected. US interests would be served equally with those of the Soviets only if agreement could be reached to exchange geodetic data and large-scale maps of areas within a radius of several hundred miles of the Strait.

(3) Gravity observations: Gravity values from all over the earth's surface provide a unique method of determining the shape of the earth. The Soviets have found the gravity approach to geodesy most helpful in setting up their datum and in reducing measured angles and distances to the ellipsoid. To obtain a better understanding of the relationship between the earth's surface, the geoid, and ellipsoid, it has long been recognized that gravity observations from representative areas all over the earth are needed. Because intercontinental positioning will be improved as these gravity observations are made, the data assume the significance of military information. The overlapping interest in gravity by scientists and military planners has led to conflict of opinion over the release of data in the US and to strict withholding of the data in the USSR. There is little prospect for relaxation of the Soviet policy with respect to gravity data in the near future.

The urgency for obtaining gravity data from all over the earth has given precision instrument builders an incentive to create apparatus for measuring gravity on surface ships in moderately calm seas. Heretofore gravity at sea has been measured by pendulum apparatus (Vening Meinesz type) in a submerged submarine. This method has been slow and costly and is not suited to a worldwide oceanic gravity program. Promising results from surface vessels have been achieved by the US within the past year, using stabilized platforms, gravimeters similar to portable land types, and electronic circuitry for continuous recording. The Soviets are definitely working along the same lines but are very guarded in what they reveal concerning their progress. They have experimented with ship-borne apparatus with apparent success. In this field they may even be ahead of the US. If gravity can be measured reliably on surface vessels, the transition to airborne measurement presents no serious technical difficulty. The US is already testing airborne gravimeters, and the Soviet Union is possibly doing the same. Within the next 5 years the Soviet Union, working independently on the sea and in the air, should acquire enough new gravity data to justify their recalculation by them of geoidal heights and undulations over the entire earth's surface. In the conquest of science as a pathway toward world power, there is no doubt that the Soviets aim to be foremost among nations in the study of the structure of the earth. Gravity provides a key method of approach to this study.

(4) Soviet IGY geodetic work in Antarctica: Astronomic observations have in the past provided the basic control for whatever mapping has been done of Antarctica. Aside from the usual triangulation between astro

points, geodetic interest in Antarctica centers upon gravity determinations made in the area. It is believed that during the IGY the Soviets made extensive gravity determinations at Mirny, at various points on their inland excursions to set up meteorological stations, and in the coastal waters traversed by their oceanographic vessels. Because such gravity observations were outside the scope of IGY planning, the Soviets were not obligated to disclose these gravity data. Prior to the commencement of the IGY the Soviets seemed anxious to compare their gravimeter readings with those of the US at Mirny. This would be desirable for calibrating the instruments, since some drift by a gravimeter is to be expected. When a US Worden gravimeter was brought ashore at Mirny, however, the Soviets were unwilling to put their own gravimeter to any sort of test. Since gravity values have to be reduced to sea level to be of comparative value, inland Antarctic observations suffer from uncertainty regarding station elevation. The Soviets probably made many inland observations, using the best barometric means available to determine elevations. Such a gravity program would, in the Soviet manner of thinking, be a necessary preliminary for control of the accuracy needed for an earth satellite observation station. The Soviets were probably more interested in making gravity observations on their sea and land expeditions during the IGY than is indicated in the printed record of their achievements. With the establishment of additional stations for the observation of earth satellites, the Soviets may be expected to stress the making of gravity observations in Antarctica even more strongly in the future.

(5) Geodesy from earth satellites: Geodesy will ultimately benefit greatly from the study of earth satellites. Methods will be found to

improve intercontinental positioning, to get a better value of the earth's flattening, and to determine the earth's gravity anomalies. For geodetic purposes, a number of earth satellites at different altitudes above the earth and different eccentricity and inclination of orbit are needed. More refined methods are also required for determining the position of the satellite and the time of its observation. Also needed are accurately positioned stations well distributed over the earth. Although no admission has come from the Soviets, it is evident that their satellite program suffers from dependence upon other parts of the world to contribute observational data. The Soviet Union is just not big enough so that observations from that country alone are sufficient for the study of precise orbits. This is why the Soviets will undoubtedly set up stations in Antarctica, remote from the USSR.

The US should not be overanxious in looking for geodetic gains from the study of earth satellite orbits. Technology must first provide the thrusts necessary to attain orbits several thousand miles from the earth; only through the analysis of data from a number of such orbits can consistent final results be obtained. The present outlook is for continued aloofness on the part of the Soviets in sharing their raw observational data. Because of the frictions developed by a dual satellite program, of the US and USSR, geodetic advance may be slower than otherwise; but the competition will ultimately lead to geodetic results of great significance to mapping.

(6) Mapping in support of military capabilities: Some of the Soviet accomplishments in mapping their own country have already been pointed out. Mapping at large scale in the buffer areas of the European

Sovbloc countries is well on its way toward completion, as was planned at Sofia in 1952. It can be assumed that the Soviets are well supplied with all US maps that are freely obtainable in this country. Soviet holdings of foreign maps have the great advantage of up-to-dateness. In contrast, US holdings of Soviet maps are of World War II date and do not reflect the newly adopted Soviet geodetic system; they are also incomplete and out of date in planimetric natural and cultural detail. From the standpoint of mapping preparedness for ICBM type warfare, the Soviets have a clear target-positioning advantage over the US -- the result of Soviet denial of their own maps to other nations.

Approved For Release : CIA-RDP62-00680R000200190060-1

Approved For Release : CIA-RDP62-00680R000200190060-1

S-E-C-R-E-T